# The Use of Pregraded Whole Seed and the Gravity Table in the Preparation of Segmented Sugar Beet Seed

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The problems confronting the processor of segmented seed differ in many respects. The germination of the whole seed, its size range, and the proportion and germination of each individual size range vary considerably. There is, likewise, a difference in the desired size range, germination, flowability, and percentage of single germ seed segments of the end product. Variation in these factors necessitates certain changes in processing methods. It is because of these factors that any or all processing methods may or may not work out satisfactorily in all cases.

The factors involved in our operations at St. George, Utah, are as follows: The desired product is a seed of a size range commonly referred to as 7/64 to 9/64 seed. Actually the size range of this product could be better defined as 6.50/64 to 8.50/64 seed. Approximately 15 percent of this product is minus 7/64; 65 percent is from 7/64 to 8/64; and 20 percent is plus 8/64. The processing required after the segmented seed has been graded brings about a further reduction in size. This seed is for use in precision planters and must of necessity be a standard product because the cell dimensions of the Cobbley rotors were designed for a seed of the afore-mentioned size range. A larger proportion of minus 7/64 seed reflects itself in doubles planted and a high breakage index. Likewise a larger proportion of plus 8/64 seed would hinder proper planter performance. The desired germination is 90 percent with approximately 90 percent singles. The desired qualities are deemed to be of sufficient importance to maintain regardless of recovery.

The whole seed to be processed has in our case been almost entirely U. S. 22 and TJ. S. Improved 22. The whole seed product has been very uniform and of high germination (approximately 90 percent). This seed will range in size from 7.50/64 to plus 15/64. A 16-hour composite of the whole seed introduced was analyzed to determine seedlings per seed ball and total germination. These data are shown in table 1. The germination figures are shown on the three sizes that are segmented. The percentage of each size is also shown.

It is of interest to note in this table that the percentage of singles is not always the true indication of the value of any given lot of seed

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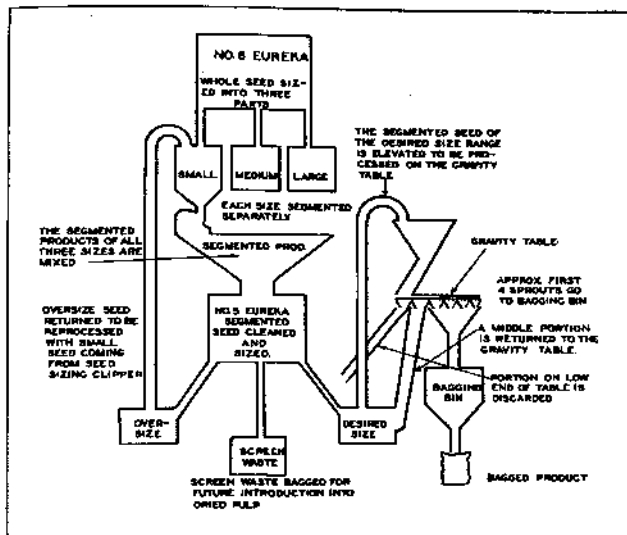
for final plantings. The percentage of singles may exceed 50 percent but the percentage of doubles and triples would necessitate segmenting of the product.

Table 1.—Whole seed, 16-hour composite. St. George, Utah.

| | Pounds per 100 pounds of whole seed | Seedlings per seed ball | | | | Seedlings per 100 seed balls | Seed balls producing 1 or more seedlings |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 8 | 4 or more | | |
| Whole seed before sizing | 100.0 | 48.5 | 34.5 | 16.0 | .5 | 149.3 | 98.5 |
| After sizing | | | | | | | |
| Small seed 6/64 to 9.5/64 | 25.3 | 48.5 | 24.5 | 3.0 | 1.5 | 112.5 | 77.5 |
| Medium seed 9.5/64 to 11/64 | 58.7 | 31.0 | 40.5 | 18.5 | ..... | 167.5 | 90.0 |
| Large seed over 11/64 | 16.0 | 26.5 | 35.0 | 22.0 | 7.0 | 189.5 | 94.5 |

Table 2.—Results of test to determine size range of smalt size seed.  Variety U. S. 22
    and improved; 1944 crop.*

| Size of screen used | Percent of seed retained on screen | Percent of seed passed through screen | Percent of waste in process |
|---|---|---|---|
| 7.75/61 | 96.8 | 2.7 | .5 |
| 8/44 | 88.3 | 11.0 | .7 |
| 8.5/64 | 89.1 | 10.4 | .5 |
| 9/64 | 79.3 | 19.8 | .9 |
| 9.5/64 | 73.9 | 25.3 | .8 |

*Screens used were 3/4-inch slotted.   Sizing work was done with a No. 6 Eureka cleaner.

The whole seed grown in southern Utah is normally of large size.
This is demonstrated by the results recorded in a test to determine
where the break should come in determining the small size seed for
segmenting.   The results are presented in table 2.   No appreciable
break in the seed size came until the seed was screened through the
9/64 three-fourths-inch slotted screen.   This percentage was not
sufficient, however, so we standardized on the 9.5/64.   The medium
size seed is that passing through the 11/64 and retained on the
9.5/64. and the large sized seed is that retained on ihe 11/64.   All
screens used in the sizing operation are three-fourths-inch slotted
screens.   Each size is segmented separately and the segmented por-
tions of all three sizes are discharged onto a No. 5 Eureka cleaner
where the grading of the segmented seed is done.   The desired size
then goes to the gravity table where the germination is raised to
approximately 90 percent ; the seed is then bagged.   The oversize, or
seed that is plus 9/64 in size, is returned and mixed with lhe smaller
size whole seed for an additional segmenting.   A flow sheet is shown
in table 3.

It is in the segmenting of the seed that the limits of recovery are
determined.   An inefficient processing of the desired product may
reflect itself rn recovery losses of 3 to 4 percent on seed introduced,
whereas losses in recovery of 10 to 15 percent may be experienced with

Table 3.—Segmenting and processing plan used by Utah-Idaho Sugar Compan.y

Screens Used In Sizing Whole Seed Listed below
    Lower screen...........................6/64-inch, 3/4 inch slotted
    Middle  screen.............9.5/64        inch, 3/4 inch slotted
    Top        screen.. . . . .. 11/04-inch, 3/4, inch  slotted

Size Range of Seed
    Everything passing through the lower screen is discarded as waste.
**Small Size**—Seed psissed through 9.5/64-inch screen and retained on the 6/64-inch
    screen.
**Medium Size**—Seed passed through 11/64- inch screen and retained on the 9.5/64 inch
    screen.
**Large Size**—Seed retained on the 11/64-inch screen.

inefficient segmenting technique. Processing procedures have to a major degree been mastered to the point that very acceptable recoveries are possible from the segmented seed delivered to the process. This cannot be said of the whole seed being delivered to the segmenting operation. Tt is this problem of segmenting that has been and is the major interest in onr operations. The following remarks relate principally to this subject.

In an attempt to gain a better understanding of the segmenting operation and attain better control, the following procedure was fol-

Table 4.—Screen analysis of samples composited every 2 hours for an 8-hour period at seed plant located at St. George, Utah.

| | Wheel No. | Percent seed retained on 9/64-inch round-hole screen | Percent of 7/64 to 9/64 seed recovered | Percent seed through 7/64-inch round-hole screen | Percent germination of seed 7/64 to 9/64 |
|---|---|---|---|---|---|
| Wheels 1, 2, and 3 segment all small seed and all oversize seed coming from the segmented seed screening operations. | Average No. 1 | 82.5 | 36.5 | 81.0 | 71 |
| Wheels 1 and 2 handled 75 percent of the oversize; the other 25 percent was handled by wheel 3. | Average No. 2 | 35.7 | 31.9 | 32.4 | 66 |
| The small seed and oversize were mixed before segmenting. | Average No. 3 | 26.2 | 30.2 | 43.6 | 69 |
| Average for wheels 1, 2 and 3 . | | 31.47 | 32.87 | 35.66 | 68.67 |
| | Average No. 4 | 40.3 | 21.3 | 38.4 | 75 |
| | Average No. 5 | 42.0 | 20.1 | 37.0 | 73 |
| | Average No. 6 | 40.7 | 20.0 | 38.4 | 76 |
| Average for wheels 4, 5 and 6. | | 41.80 | 20.77 | 37.93 | 74.67 |
| Wheels 7 and 8 segmented the large size seed. | Average No. 7 | 48.8 | 18.0 | 33.2 | 73 |
| | Average No 8 | 52.7 | 14.7 | 32.0 | 62 |
| Average for wheels 7, 8 | | 50.75 | 16.35 | 32.90 | 67.50 |

lowed for an 8-hour period at our seed plant at St. George, Utah: The segmented product delivered from each segmenting wheel was sampled regularly and the samples from each wheel were composited every 2 hours. A screen and germination analysis was made on each of these composites. Table 4 shows the results of this work.

Average recovery figures for the 8-hour period were as follows: For the three wheels segmenting the small and oversize seed from all three sizes, 32.87 percent 7/64 to 9/64 seed, 31.47 percent oversize, and 35.66 percent waste. For the three wheels segmenting the medium type seed,2 0.77 percent 7/64 to 9/64 seed, 41.30 percent oversize, and 37.93 percent waste. For the two wheels segmenting the large seed. 16.35 percent 7/64 to 9/64 seed, 50.75 percent oversize, and 32.90 percent waste. It was of interest to note that the No. 3 wheel, which was segmenting the least amount of oversize in conjunction with small seed, showed a recovery of 7/64 to 9/64 seed that was 2.67 percent lower than the other two wheels. The initial loss in waste and the low percentage of oversize reflects itself in a lower recovery. This would indicate a definite advantage in adding the oversize to the small seed in this operation. A series of tables (Nos. 5, 6, 7, and 8) are presented in this paper showing calculated recoveries of 7/64 to 9/64 seed, using the recovery figures obtained from the composite samples taken during an 8-hour operation. This method of calculating recoveries has been quite accurate and is presented in detail. This method, as is pointed out in the tables, is simply that of calculating the recovery on the flow of seed through the plant on the basis of a composite sample.

The flow of seed as indicated in table 5 is of great importance in making possible a method of control for better recovery. As indicated in table 1, the initial indication of whole seed would be as follows: For every 100 pounds of seed introduced, 25.3 pounds would go to wheels 1, 2, and 3 as small seed, 58.7 pounds to wheels 4, 5, and 6 as medium size seed, and 16 pounds to wheels 7 and 8 as large seed. As indicated by the recovery figures in table 3, 31.41 percent of the small seed, or 7.96 pounds of the original 25.3 pounds, would return as oversize. A like return of 24.24 pounds of the original medium size seed and 8.43 pounds of the original large seed would occur. The pounds of oversize from the original poundage introduced would again be subject to the same average recovery figures that were used to determine the pounds of return seed in the first case. In calculating recoveries with this method it would appear that from a given 100 pounds of seed introduced, portions thereof would be segmented through the segmenting operation from four to five times before the recovery would be complete. Thus, of the original 100 pounds of whole seed introduced, 25.3 pounds of small seed plus 40.63 pounds of oversize would be segmented by the three wheels segmenting the small

Table 5.—Calculated recovery of 7/64 to 9/64 segmented seed.

| | Pounds introduced | Pounds recovered | Pounds waste | Pounds oversize |
|---|---|---|---|---|
| | | Small Seed | | |
| First segmenting | 100.00 | 32.87 | 35.66 | 31.47 |
| First return | 31.47 | 10.34 | 11.23 | 9.90 |
| Second return | 9.90 | 3.25 | 3.53 | 3.12 |
| Third return | 3.12 | 1.03 | 1.11 | .98 |
| Fourth return | .98 | .32 | .35 | .31 |
| Total | 100.00 | 47.81 | 51.88 | |
| | | Medium Seed | | |
| First segmenting | 100.00 | 20.77 | 37.93 | 41.30 |
| First return | 41.30 | 13.57 | 14.73 | 13.00 |
| Second return | 13.00 | 4.27 | 4.64 | 4.09 |
| Third return | 4.09 | 1.34 | 1.46 | 1.20 |
| Fourth return | 1.20 | .42 | .46 | .41 |
| Total | 100.00 | 40.37 | 59.22 | |
| | | Large Seed | | |
| First segmenting | 100.00 | 16.85 | 32.90 | 50.75 |
| First return | 50.75 | 18.08 | 18.10 | 15.97 |
| Second return | 15.97 | 5.25 | 5.70 | 5.02 |
| Third return | 5.02 | 1.65 | 1.79 | 1.58 |
| Fourth return | 1.58 | .52 | .56 | .50 |
| Total | 100.00 | 40.45 | 59.04 | |

| | Size of seed Pounds per 100 pounds whole seed | Percent recovery first segmenting | Pounds recovery first segmenting | Percent recovery on return segmenting | Pounds recovery on return segmenting | Total pounds recovery |
|---|---|---|---|---|---|---|
| Small seed | 25.30 | 32.87 | 8.32 | 32.87 | 3.78 | 12.10 |
| Medium seed | 58.70 | 20.77 | 12.19 | 32.87 | 11.51 | 23.70 |
| Large seed | 16.00 | 16.85 | 2.62 | 32.87 | 3.85 | 6.47 |
| ALL SEED | 100.00 | | 23.13 | | 19.14 | 42.27 |

and oversize seed. In other words, these three wheels are responsible for the recovery of 7/64 to 9/64 seed from 65.93 pounds of every 100 pounds of whole seed introduced to the process. It is also of interest to note that of the total pounds of recovery (42.27), 23.13 pounds were obtained in the initial segmenting and 19.14 pounds by the subsequent working of the oversize from the initial segmenting. The overage germination of the 42.27 pounds of recovered 7/64 to 9/64 seed was approximately 70 percent. Thus, if no processing loss occurred, approximately 22 percent of the 30 percent of non-variable matter Would have to be removed to raise the germination to 90 percent. This would amount to 9.27 pounds on seed introduced but would, of course, not be possible with present processing procedures.

A certain amount of the viable segments are lost in processing and additional losses in poundage are experienced in the scarification that takes place after the seed has been graded to the desired size. Approximately 1 additional pound of viable seed, plus a small loss in dust, would bring the recovery of 90-percent germination 7/64 to 9/64 seed to approximately 31 percent on seed introduced. This was almost identical with the recovery recorded for the day this test was made.

Tables 6, 7, and 8 present calculated recoveries of 7/64 to 9/64 segmented seed from the composite samples of the individual wheels on the small, medium, and large seeds. The samples in each case have been grouped, with the oversize varying about 10 percent in each case. It would appear in the case of the small seed that maximum recoveries are best obtained by recovering as large a percentage of the desired size range as possible in the initial segmenting operation. This has been true in all the work we have done during the past 3 years.

Table 6.—Calculated recovery of 7/64 to 9/64 segmented seed. The 12 composited samples from wheels 1, 2, and 3 have been grouped in three groups with the oversize varying about 10 percent with each group.

| | Pounds Introduced | Pounds recovered | Pounds waste | Pounds oversize |
|---|---|---|---|---|
| | | | Small Seed | |
| **First group** | | | | |
| First segmenting | 100.00 | 28.72 | 31.06 | 40.32 |
| First return | 40.32 | 13.25 | 14.38 | 12.69 |
| Second return | 12.69 | 4.17 | 4.53 | 3.99 |
| Third return | 3.99 | 1.31 | 1.42 | 1.26 |
| Fourth return | 1.26 | .41 | .45 | .40 |
| Total | 100.00 | 47.84 | 51.76 | |
| **Second group** | | | | |
| First segmenting | 100.00 | 31.05 | 36.25 | 32.70 |
| First return | 32.70 | 10.75 | 11.66 | 10.29 |
| Second return | 10.29 | 3.38 | 3.67 | 3.24 |
| Third return | 3.24 | 1.06 | 1.16 | 1.02 |
| Fourth return | 1.02 | .34 | .36 | .32 |
| Total | 100.00 | 46.58 | 53.10 | |
| **Third group** | | | | |
| First segmenting | 100.00 | 38.82 | 39.82 | 21.35 |
| First return | 21.35 | 7.02 | 7.61 | 6.72 |
| Second return | 6.72 | 2.21 | 2.40 | 2.11 |
| Third return | 2.11 | .69 | .75 | .67 |
| Fourth return | .67 | .22 | .24 | .21 |
| Total | 100.00 | 48.96 | 50.82 | |

Table 7.- Calculated recovery of 7/64 to 9/64 segmented seed. The 12 composited samples from wheels 4, 5, and 6 have been grouped in three groups with the percentage oversize varying about 10 percent in each group.

|  | Pounds introduced | Pounds recovered | Pounds waste | Pounds oversize |
|---|---|---|---|---|
| **Medium Seed** | | | | |
| **First group** | | | | |
| First segmenting | 100.00 | 17.88 | 31.07 | 51.05 |
| First return | 51.05 | 10.78 | 18.20 | 16.07 |
| Second return | 16.07 | 5.28 | 5.73 | 5.06 |
| Third return | 5.06 | 1.66 | 1.81 | 1.59 |
| Fourth return | 1.59 | .52 | .57 | .50 |
| Total | 100.00 | 42.12 | 57.38 | |
| **Second group** | | | | |
| First segmenting | 100.00 | 21.05 | 38.06 | 40.88 |
| First return | 40.88 | 13.44 | 14.58 | 12.86 |
| Second return | 12.86 | 4.23 | 4.58 | 4.05 |
| Third return | 4.05 | 1.33 | 1.45 | 1.27 |
| Fourth return | 1.27 | .42 | .45 | .40 |
| Total | 100.00 | 40.47 | 59.14 | |
| **Third group** | | | | |
| First segmenting | 100.00 | 23.53 | 44.60 | 32.08 |
| First return | 32.08 | 10.54 | 11.44 | 10.10 |
| Second return | 10.10 | 3.32 | 3.60 | 3.18 |
| Third return | 3.18 | 1.05 | 1.13 | 1.00 |
| Fourth return | 1.00 | .33 | .36 | .31 |
| Total | 100.00 | 38.56 | 61.13 | |

This is not. however, the case with the medium and large size seed. Maximum recoveries nre indicated with the large seeds when smaller percentages of 7/64 to 9/64 seed are recovered on the initial operation with a fairly large amount of oversize. This is very evident in table 7. The indicated final recovery varied from 38.56 to 42.12, as the oversize from the initial operation varied from 32.8 to 51.05. The results presented in this paper and the operation itself are not presented as the ideal operation. Actually, final recoveries were approximately 4 to fi percent lower than we normally expect. This information is merely presented in an attempt to point out where recoveries can be increased and the method of calculating recoveries at the time that segmenting is being carried on. On table 8 it will be noted in the second group that the oversize averaged 55.94 percent of the seed introduced. In no case should this percentage of oversize exceed 50 percent if maximum recovery is to be expected.

Table 8.—Calculated recovery of 7/64 to 9/64 segmented seed.  The 8 composited sam-
ples from wheels 7 and 8 have been grouped in two groups with the oversize
varying about 13.5 percent with each group.

| | Pounds introduced | Pounds recovered | Pounds waste | Pounds oversize |
|---|---|---|---|---|
| | | Large Seed | | |
| **First group** | | | | |
| First segmenting | 100.00 | 21.63 | 36.20 | 42.17 |
| First return | 42.17 | 13.86 | 15.04 | 13.27 |
| Second return | 13.27 | 4.36 | 4.73 | 4.18 |
| Third return | 4.18 | 1.37 | 1.49 | 1.32 |
| Fourth return | 1.32 | .43 | .47 | .42 |
| Total | 100.00 | 41.65 | 57.93 | |
| **Second group** | | | | |
| First segmenting | 100.00 | 13.28 | 30.78 | 55.94 |
| First return | 55.94 | 18.39 | 19.95 | 17.00 |
| Second return | 17.00 | 5.78 | 6.28 | 5.54 |
| Third return | 5.54 | 1.82 | 1.98 | 1.74 |
| Fourth return | 1.74 | .57 | .62 | .55 |
| Total | 100.00 | 39.84 | 59.61 | |